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## Evaluation of the effects of performance dentistry on equine rideability: a randomized, blinded, controlled trial

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### ABSTRACT

**Objective:** This study attempted to determine: (1) if degree of dental malocclusion assigned prior to dental treatment was associated with equine rideability, assessed using a standardized score and (2) if performance dentistry improved this score.

**Animals:** Thirty-eight Franches-Montagnes stallions.

**Methods:** All horses were examined and assigned a dental malocclusion score by a veterinary dentist and randomized into two groups: sham treatment (Group S) and performance dentistry including occlusal equilibration (Group D). The horses were ridden twice before and three times after treatment by a professional dressage rider (unaware of treatment allocation). The horses were assigned a rideability score using a 27-point scale. The malocclusion score was compared to the average of the first two rideability scores using Spearman's coefficient of rank. Change in rideability scores over time was assessed by repeated measures ANOVA. Statistical significance was set at  $P < 0.05$ .

**Results:** There was no correlation between dental score and rideability score prior to treatment ( $r_s = 0.06$ ,  $P = 0.73$ ). In addition, there were no differences in the rideability score between treatment groups or as an interaction of treatment group and time ( $P = 0.93$ ,  $P = 0.83$ , respectively).

**Conclusions:** In conclusion, we were unable to show that performance dentistry improved equine rideability assessed by rider scoring. The addition of more objective measurement tools and a longer assessment period may help to scientifically prove what is anecdotally believed.

### ARTICLE HISTORY

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Equine; horse; dentistry; malocclusion; rideability

## 1. Introduction

References relating to equine dentition, equilibration of dental arcades and removal of sharp points protruding to soft tissue can be found dating back hundreds of years (Chuit 2006). As equine dentistry evolved, treatment became more sophisticated and four levels of equine dental care (EDC) were recently described (Easley et al. 2010).

Performance dentistry refers to the second level of EDC and includes occlusal equilibration, dental prophylaxis and additional procedures. The goal of performance dentistry is to make the horse comfortable, improve the horse's ability to accommodate the bit or other equipment and allow free rostrocaudal mobility (RCM) and lateral excursion of the mandible.

Prophylactic and regular dental work has been attributed to improved rideability but despite anecdotal evidence from professional riders and equine veterinarians (Practitioners AAoE 1999; Bryant 2014; Miller 2014), there has been little scientific research into the effects and benefits of performance dentistry on the rideability of the horse. Many factors affect rideability including conformation, training level, health of the

horse and ability of the rider. Recent research has shown that good rideability of a horse while being judged in a standardized performance dressage test was consistently associated with lower rein tension (Konig von Borstel & Glissman 2014). Assuming rein tension may be related to oral health and comfort of the horse, specifically regarding malocclusion, it would be reasonable to assume that performance dentistry may improve rideability. However, to our knowledge, there is no scientific evidence in horses to support this claim.

A recent study in healthy women showed that an artificially induced oral malocclusion led to an average 9% decrease in eccentric peak torque of the hamstring (Grosdent et al. 2014). Furthermore, studies have shown that elite human athletes report dental disease has a negative impact on their performance (Needleman et al. 2013, 2016). Therefore, we propose that malocclusion might also impact the performance of sport horses.

The intention of this research was to investigate if performance dentistry had a positive effect on the rideability of a horse. Specifically, an attempt was made to

determine if: (1) the degree of dental malocclusion assigned prior to dental treatment was associated with the rideability of the horse, assessed using a standardized score and (2) performance dentistry improved this rideability score. We hypothesized performance dentistry compared to sham treatment would improve rideability, as judged by a professional rider.

## 2. Materials and methods

### 2.1. Animals

This study was approved by the Commission of Animal Experimentation of the Canton of Vaud, Switzerland (No. 2588.0). The study was conducted using Franches-Montagnes stallions owned by and with informed consent from the National Stud in Avenches, Switzerland.

### 2.2. Study design, inclusion and exclusion criteria

This study was designed as a prospective, controlled, blinded and randomized trial conducted within a three-month period on-site at the National Stud where the horses were normally housed. All regularly ridden stallions housed at the stud were considered potential candidates. A lameness exam was performed on these candidates ( $n = 40$ ) and only sound animals were included in the study.

All horses were assigned an individual number and a comprehensive dental examination was performed by the same veterinary dental specialist. The dental exam included, but was not limited to: manual assessment of the temporomandibular joint, symmetry and dentition. Pathologies such as fractured crowns, diastema, periodontal disease and endodontic disease were recorded on a standardized protocol (Appendix). These observations were documented and the dentist then categorized the horses into four groups according to the severity of dental malocclusions: (1) no enamel points and no occlusal problems, (2) sharp enamel points but no occlusal problems, (3) sharp enamel points with mild occlusal problems [restricted RCM or increased lateral jaw excursion to molar contact (EMC)] and (4) sharp enamel points and major occlusal problems (no EMC or RCM). A manual examination of the temporomandibular joint for pain was performed as well.

Block randomization into one of two groups [dental treatment (Group D) or sham examination (Group S)] was performed by pulling letters out of a hat. Horses with a dental malocclusion score of 1 and 2 were in the first randomization set and those with a score of 3 and 4 in the second set.

### 2.3. Procedures

Two weeks after the initial dental examination, horses were sedated with 80 mcg/kg BW intravenous

romifidine (Sedivet, Boehringer Ingelheim, Basel, Switzerland) combined randomly with either 18 mcg/kg BW butorphanol (Albegasic 1%, Virbac, Glattbrugg, Switzerland) or saline intravenously as part of a concurrent research trial (Marly et al. 2014).

Horses were placed in a suspension system (Dental Halter, Rope and Locking Cleat, Equine Specialties, Morristown, AZ, USA) and those assigned to Group S had a dental speculum (4000 series, World Wide Equine, Glenns Ferry, ID, USA) placed for 30 minutes and the mouth was rinsed. The speculum was closed and reopened every 7–10 minutes during this 30-minute period. Group D horses had a speculum placed in the same manner as Group S and standardized performance dentistry was completed (Easley et al. 2010). The mouth was rinsed (EquuJet, Dental Harmony, Neuville-sur-Saône, France) and the arcades were balanced by correcting protuberant pathological findings such as enamel points and excessive transfer ridges. Transitions were blended and suitable table angles were re-established and/or maintained. Sharp enamel points were removed and rostral profiling was performed on Triadan 06s (Floyd 1991) for added comfort when carrying a bit (bit seat) [(Cheek Teeth Instruments: GT12 with Diamond Coated Rotary Burr, Carbide Products, Torrance, CA, USA; RA250 with Disc Burr and RA250 with Apple Core Burr, Horsepower, Oakley, CA, USA; Mirror; Cheek Retractor) (Canine Instruments: Apple Core Burr, Equine Specialties, Morristown, AZ, USA)]. No more than 2 mm of tooth beyond the most proximal point of natural occlusal surface was removed. Wolf teeth were removed if present. Deciduous teeth were also removed if there was some instability. Canine teeth were assessed and buffed if present.

The speculum was removed and a cheek retractor was used to control cheek teeth occlusion. When necessary, the incisor table angles were corrected, malocclusions relieved and incisors reduced to improve occlusion (Diamond Cutting Wheel, Equine Specialties, Morristown, AZ, USA). The same veterinary dental specialist performed all dental procedures. At the end of the dental treatment, all horses underwent an ophthalmologic examination with bilateral cytobrush sampling as part of a concurrent trial. Following treatment, all horses had a minimum of three days off from riding and were exercised daily in a horse walker or went to the paddock.

### 2.4. Evaluation of rideability

Horses were ridden twice by a professional Grand Prix level dressage rider, who was unaware of treatment allocation, within a five-day period just prior to dental treatment (timepoints B1 and B2). Three additional sessions took place starting five days after treatment over a two-month period (timepoints A1, A2, and A3). During these sessions, the horses were prepared and

**Table 1.** Translated scoring system used to evaluate rideability. A lower score indicates better rideability. The original version was in French.

Does the horse accept contact with the hand easily?		
Walk	No (1)	Yes (0)
Trot	No (1)	Yes (0)
Canter	No (1)	Yes (0)
Does the horse have consistent contact?	No (1)	Yes (0)
Does the horse move behind the bit?		
Walk	Yes (1)	No (0)
Trot	Yes (1)	No (0)
Canter	Yes (1)	No (0)
Consistent contact	Yes (1)	No (0)
Does the horse pull in front of the bit?		
Walk	Yes (1)	No (0)
Trot	Yes (1)	No (0)
Canter	Yes (1)	No (0)
Consistent contact	Yes (1)	No (0)
Does the horse tilt its head while ridden?	Yes (1)	No (0)
Does the horse grind its teeth?	Yes (1)	No (0)
Does the horse lock its mouth?	Yes (1)	No (0)
Does the horse have difficulty to bend to the left?		
Walk	Yes (1)	No (0)
Trot	Yes (1)	No (0)
Canter	Yes (1)	No (0)
Does the horse have difficulty to bend to the right?		
Walk	Yes (1)	No (0)
Trot	Yes (1)	No (0)
Canter	Yes (1)	No (0)
Is the horse relaxed on the bit?	No (1)	Yes (0)
Does the horse have consistent contact between hand and mouth?	No (1)	Yes (0)
Does the horse easily move over the back onto the hand?	No (1)	Yes (0)
Does the horse move forward through the hand well?		
Walk	No (1)	Yes (0)
Trot	No (1)	Yes (0)
Canter	No (1)	Yes (0)
Maximum score 27		

warmed up for 20 minutes by their normal riders. The horses were then ridden by the professional rider for an additional 20 minutes in prescribed individual dressage lessons (straight line; 10 and 20 m circles; hand change across the arena; gait changes of walk, trot, canter and halt) and rideability was scored using a 27-point scale (Table 1). A lower score indicated better rideability. Every horse was ridden with a normal snaffle bit and an English nose band. The rider used his own saddle. The primary outcome was the proportion of horses showing an improved rideability score over time and the secondary outcome was the correlation of the assigned dental score to the rideability score prior to treatment.

## 2.5. Statistics

The sample size was determined by the number of horses available at the National Stud. Statistics were performed using MedCalc Statistical Software version 16.8 (MedCalc Software bvba, Ostend, Belgium) and data were treated as non-parametric. The malocclusion score was compared to the average of the first two rideability scores using Spearman's coefficient of rank and the averaged rideability score was classified into

above versus below average score and compared to the simplified malocclusion score (low [scores 1 and 2] versus high [3 and 4]) using a Chi-squared test. Furthermore, change in rideability over time was first assessed by repeated measures ANOVA including treatment effect as a between subject factor (treated versus sham-treated), the examined time points (B1, B2, A1, A2, A3) and the interaction of the two. A non-parametric Friedman's test was also used to investigate repeated measure effects over time, separately for the treated and the sham-treated groups. Statistical significance was set at  $P < 0.05$ .

## 3. Results

### 3.1. Horses

Thirty-eight stallions were included in the study; two were excluded for lameness. The mean  $\pm$  standard deviation age was  $10 \pm 5$  and  $11 \pm 5$  years in Group D and Group S, respectively. Data are missing as a result of missed training sessions for one horse in Group D at timepoint A2 and one horse in Group S at timepoint B2. Three horses in Group D showed primary pathologies (two with fractured crowns and one with diastema).

### 3.2. Malocclusion score

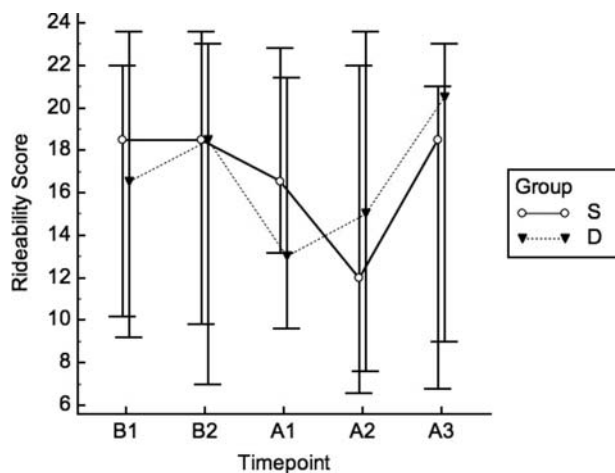
On initial examination, 9 horses were assigned a malocclusion score of 1 (Group D,  $n = 5$ ; Group S,  $n = 4$ ); 10 a score of 2 (Group D  $n = 5$ ; Group S  $n = 5$ ); 9 a score of 3 (Group D,  $n = 4$ ; Group S,  $n = 5$ ) and 10 a score of 4 (Group D,  $n = 5$ ; Group S,  $n = 5$ ). There was no correlation between malocclusion score and rideability score prior to treatment ( $r_s = 0.06$ ,  $P = 0.73$ ) and no difference when above versus below average scores were compared to the simplified malocclusion score (low versus high) ( $P = 0.52$ ).

### 3.3. Rideability score

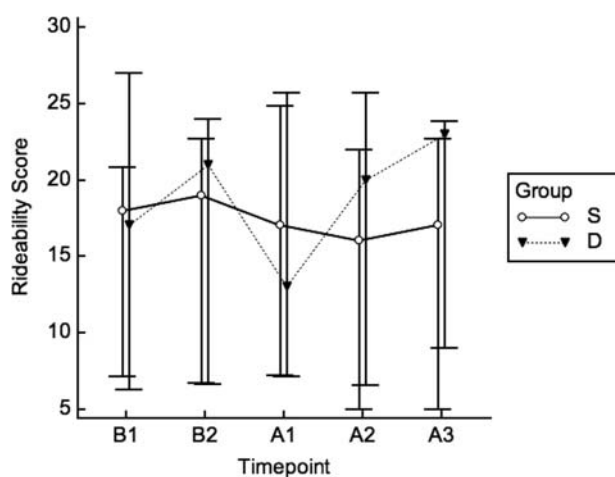
There were no differences in the rideability score between treatment groups (Table 2) or as an interaction of treatment group and time (repeated measures

**Table 2.** The median (range) rideability scores assigned by a professional rider for horses ( $n$ ) ridden two times before (B1, B2) and three times after (A1, A2, A3) performance dentistry (Group D) or sham treatment (Group S).

Timepoint	Group	$n$	Rideability score
B1	S	19	19 (5–26)
	D	19	16 (5–27)
B2	S	18	19 (5–27)
	D	19	18 (4–27)
A1	S	19	16 (5–26)
	D	19	13 (5–27)
A2	S	19	12 (4–26)
	D	18	15 (4–27)
A3	S	19	18 (5–27)
	D	19	19 (2–25)



**Figure 1.** Rideability scores [median (95% confidence interval)] for horses ridden two times before (B1, B2) and three times after (A1, A2, A3) performance dentistry ( $n = 18$ , Group D) or sham treatment ( $n = 18$ , Group S). There were no significant differences over time or between groups.



**Figure 2.** Rideability scores [median (95% confidence interval)] for horses with a high malocclusion score (3 or 4 out of 4). The horses were ridden two times before (B1, B2) and three times after (A1, A2, A3) performance dentistry ( $n = 9$ , Group D) or sham treatment ( $n = 9$ , Group S). There were no significant differences over time or between groups.

ANOVA,  $P = 0.93$ ,  $P = 0.83$ , respectively) (Figure 1). The Friedman's test, as well, did not reveal any significant effects over time in either the horses who were administered performance dentistry or the sham-treated group ( $P = 0.88$  and  $P = 0.22$ , respectively). This lack of measurable effect remained even when only treated horses with a high malocclusion score of 3 or 4 were included ( $P = 0.96$ , Figure 2).

#### 4. Discussion

There is very little scientific evidence determining the effect of regular oral care in horses. This study attempted in a controlled, randomized and 'blinded' fashion to determine if performance dentistry improved rideability, over a two-month period, but

was unable to show a treatment effect. In addition, there was no correlation between the severity of malocclusion and the rideability score assigned prior to treatment.

There are several reasons why no treatment effect was seen. First, this study only evaluated the horses over a two-month period. Performance dentistry aims to correct dental problems such as periodontitis and malocclusion, which can reduce overall health, but correcting these dental abnormalities may not immediately influence the movement or rideability of the horse. A study by Carmalt et al. (2003) showed that performance dentistry and dental equilibration improved RCM. Practitioners and laypeople believe that certain performance horses benefit from maximal mandibular excursion, especially in dressage where complete poll flexion and vertical head carriage is a necessary component of many tests. It is possible that performance dentistry improved RCM in the horses of this study, but this parameter was not measured and we hypothesize that improved RCM will, over time, improve the performance of the temporomandibular joint. Therefore, future studies should evaluate the horses over a period longer than two months such as every month for one year.

Second, the questionnaire used may not have been sensitive enough to detect an improvement in rideability. Rideability is somewhat subjective: it involves two individuals and is an art that takes years of training for the desired outcome. The questionnaire used in this study did not take into consideration the aptitude of the individual horse to react differently to new situations, which in part depends on the cooperation and talent of the horse. The willing talented horse with the worst mouth is still going to compete better than the horse with no will and/or no talent that has had regular dentistry performed. Likewise, a talented rider will get more out of an average horse than an untalented rider with the best horse. Additionally, the questionnaire was designed for dressage horses with the same training goal and same age but the population used for this study contained horses of different ages, skills and dressage levels and dentistry history. Carmalt et al. (2006) performed dental floating on dressage horse and 48 hours later judges (not the riders) scored the horses in a dressage test. No effect was seen and this further supports the hypothesis that horses need to be evaluated more often, over a longer period and with measurement other than judging and rider assessment.

Other assessments of rideability would have strengthened this study. Horses survive by disguising dental problems until they become advanced, a feature of evolution and a survival tactic in the wild. They adapt their eating patterns and behaviour to cope with developing dental pain and disease. There is also evidence that horses ridden with a bit and bridle have an increased incidence of oral ulcerations (Tell et al. 2008).



Therefore, an objective parameter would help to minimize the effects of these patterns. Recently, a study attempted to quantify rideability using rein tension and behavioural parameters (Konig von Borstel & Glissman 2014). They found that consistent rein tension was correlated with judge assigned scores indicating better rideability. For future studies, we would propose to measure rein tension scores in addition to using a refined version of the questionnaire during a more extended observation period.

Third, only one professional rider was used to evaluate rideability and he was unfamiliar with the horses. It may be difficult for a rider to correctly assess the improvement of a horse during a 20-minute training session. The rider likely would have a better impression with regular and longer training. One must also consider that problems are fixed during training. Future studies should have horses scored by a rider familiar with the horse, starting immediately after dental work.

Fourth, it is possible that performance dentistry does not produce a better rideability score. Pain on the dentition, because of the procedures could reduce the rideability score especially on a short-term basis. Future studies should also attempt to compare horses administered different types of dental procedures.

Fifth, breed may play a role in equine rideability. Stock and Distl (2008) found that traits including quality of gaits and rideability were improved by single and multiple trait selection of sires. Therefore, not only can rideability likely vary between breeds, it can also be and it often is genetically selected for within a breed. In order to minimize breed variability, this study used a homogeneous population of Franches-Montagnes stallions.

In conclusion, despite the use of a randomized, 'blinded' study design with the inclusion of a sham-treated group we were unable to show that performance dentistry improved equine rideability assessed by rider scoring. The addition of more objective measurement tools and a longer assessment period may help to scientifically prove what is anecdotally believed.

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## Disclosure statement

The authors declare that they have no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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